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ART. XVIII.—*Memorandum on certain Fossils, more particularly a new Ruminant found at the Island of Perim, in the Gulf of Cambay.* By ALDEMARLE BETTINGTON, Esq., of the Bombay Civil Service, F.G.S., M.R.A.S.

[Read 7th June, 1845.]

THE fact that fossils are found at Perim has been noticed by Baron Hugel, Captain Fulljames, and others.

In a paper published in the Journal of the Asiatic Society of Bengal, May, 1836, Captain Fulljames, who has obtained certain of these fossils, has accurately described the general appearance of the island, and the matrix in which the greater portion of the fossils are found, viz., a conglomerate of sandstone, clay, and silex. In addition to what has been written on the subject, I would observe, that the appearance of the island at the ebb of spring tides is extraordinary; and accounts for, if it will not countenance, the legend, that Perim was formerly connected with the main.

The shore shelves very gradually; and at the lowest ebb, the island appears (I speak particularly of the west side,) only separated as it were by a river from Katiwar. This is the gulf stream which sets on both sides of the Island of Perim; the channel on the Katiwar side is stated by Captain Fulljames to be seventy-five fathoms in depth, and five hundred yards in width; that between Perim and the coast of Broach is, I apprehend, greater; elsewhere the depth of the gulf about Perim and to the north, averages below fifty-five fathoms.

In relation to the present question, I would add that a vast quantity of alluvium is held in deposit, and brought down in the waters of the rivers Mhye, Sabermutty, Nerbuddah, and Taptee. In the floods, which are at the present day of frequent occurrence, large trees, and the bodies of oxen, deer, bears, and other animals, are carried down these rivers in the freshes, and so into the gulf. As regards the Mhye, the Sabermutty, and the Nerbuddah, more particularly, I wish to shew that the causes are still in operation, which would make the small Island of Perim, with its shelving shore; it being a first obstruction, and the point at which the gulf stream diverges;—I would submit that it would necessarily become the receptacle for the bones

of animals carried down by the rivers in the great land floods of past ages. Though some of the bones are preserved in a manner truly astonishing, others are rolled and broken so as to defy recognition.

It is thus, as I have attempted to shew, we may account for finding at Perim the heterogeneous collection of bones of various ruminants and pachydermata; some of animals of familiar and still existing genera, others of strange and monstrous character hitherto unclassified among fossil organic remains; the whole mixed with saurians, of which in like manner some of the co-genera are still common in the Indian rivers, and others are new, and as yet unclassified; and it is to the powerful action of the gulf stream as it sets at present,—in one direction forming new, at others removing older deposits,—that the bed which contained the chief part of the fossils I have obtained has become exposed. This bed, I should remark, is below the ordinary low water mark, and only accessible at the ebb of the highest spring tides.

I had a party employed for more than twelve months; whenever the state of the tide would admit, they went down and disengaged such masses of rock as shewed any indications of bone attached,—these were brought away in a boat from time to time.

A large quantity, chiefly bones of mastodon, I left in India; but brought to England four chests, containing the more curious and portable specimens I had the fortune to collect, some of which are now submitted for inspection. The most deserving of notice is the skull of a large animal, which I believe is now fully established and admitted as the first of a new genus as yet un-named. The mass of conglomerate which contained it weighed altogether 170 pounds; it was brought from Perim with some other specimens by my superintendent of boats, Mr. Ryan, from whom I obtained it; the labour of freeing the skull from nearly one hundred pounds weight of matrix occupied me many weeks; when cleared, as it now appears, from all superfluous matter, I shewed it in India to the late Dr. Malcolmson, who pronounced it to be great value. He and others were disposed to think it a *Sivatherium*, but this opinion has been overruled. The anomalous characteristics it presents I will presently attempt to point out.

The greater portion of the occiput, and of the dexter side of the head, are well preserved; on this side also, the maxillaries, and the alveoli of the molars, with the exception of the first, are quite perfect. The outer surfaces of the teeth are slightly injured; but the interior, and the grinding surfaces, are in great preservation; on the *left* side, the injury to the fossil from the action of water is considerable; but the tuberosity of the maxillaries is still preserved, with the alveoli

of the six molars; but the teeth themselves, though well preserved on the palatal side, are on the exterior much injured.

Whether it arises from the uneven and irregular line presented by the apparent grinding edge of the molars on the left being different from that on the right side, the eye is certainly struck with an irregularity in the outline of the base of the head. More than one person has supposed that this part of the head has received injury and become distorted; violence to such extent, however, involving the forcing in the lower maxillaries, and the alveoli of the six molars, would shew itself elsewhere, and the palatal surface in close proximity might be expected to shew a fractured line; whether this would necessarily be the case or not, I am not competent to say, but I can observe no signs of injury to the palate, and surmise that the contorted and irregular appearance arises from the destruction of the outer surface of the left molars. I should observe, that the muzzle being more truncated on one side than the other, adds to the irregularity of the outline, which diminishes to the eye, if the injured molars be covered, and allowance be made for the deficiency in the muzzle on the opposite side.

With marked and important deviations, it still bears greater affinity to the *Sivatherium* than to any hitherto discovered fossil. I have availed myself of the detailed measurements, given in the well-known paper by Captain Cautley and Dr. Falconer, (published in the *Asiatic Researches* of 1837,) to assist me in an attempt to give a comparative measurement of the new fossil. If the measurement shall prove useful it will be due to the guidance thus obtained.

Captain Cautley and Dr. Falconer compared the *Sivatherium* with the elephant and the rhinoceros. It was considered by certain of the French geologists, that the *Sivatherium* presented points of affinity to the giraffe; this, however, has been disputed, but the skull of the Perim fossil, however widely differing in other respects, has peculiarities of formation, still more than the *Sivatherium*, allied to the giraffe, particularly a very remarkable contraction of the frontal bone above the orbits, in which respect it varies widely from the *Sivatherium*, which exhibits on the contrary a widely expanded frontal like an elephant. For the satisfaction of those who wish to examine the several points of difference and those of affinity, I have compared the three, viz., the Perim fossil, the *Sivatherium*, and the skull of an adult giraffe now in the British Museum. As I have but little experience in such matters, these measurements must be received accordingly; I was occupied several days upon this work, measuring and remeasuring, and took every care in my power to make them true.

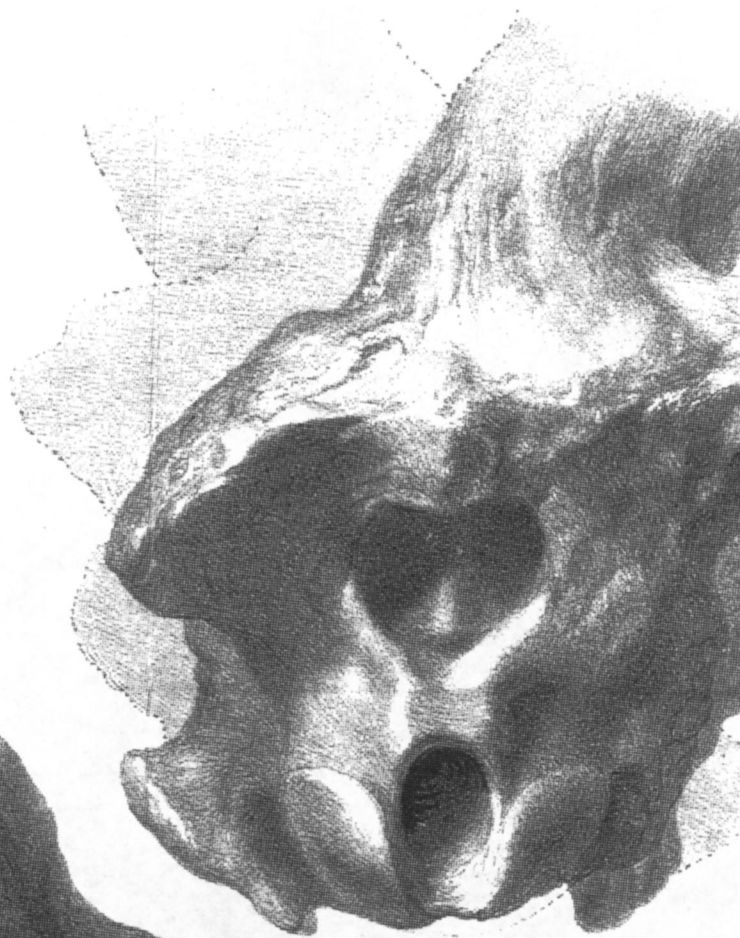


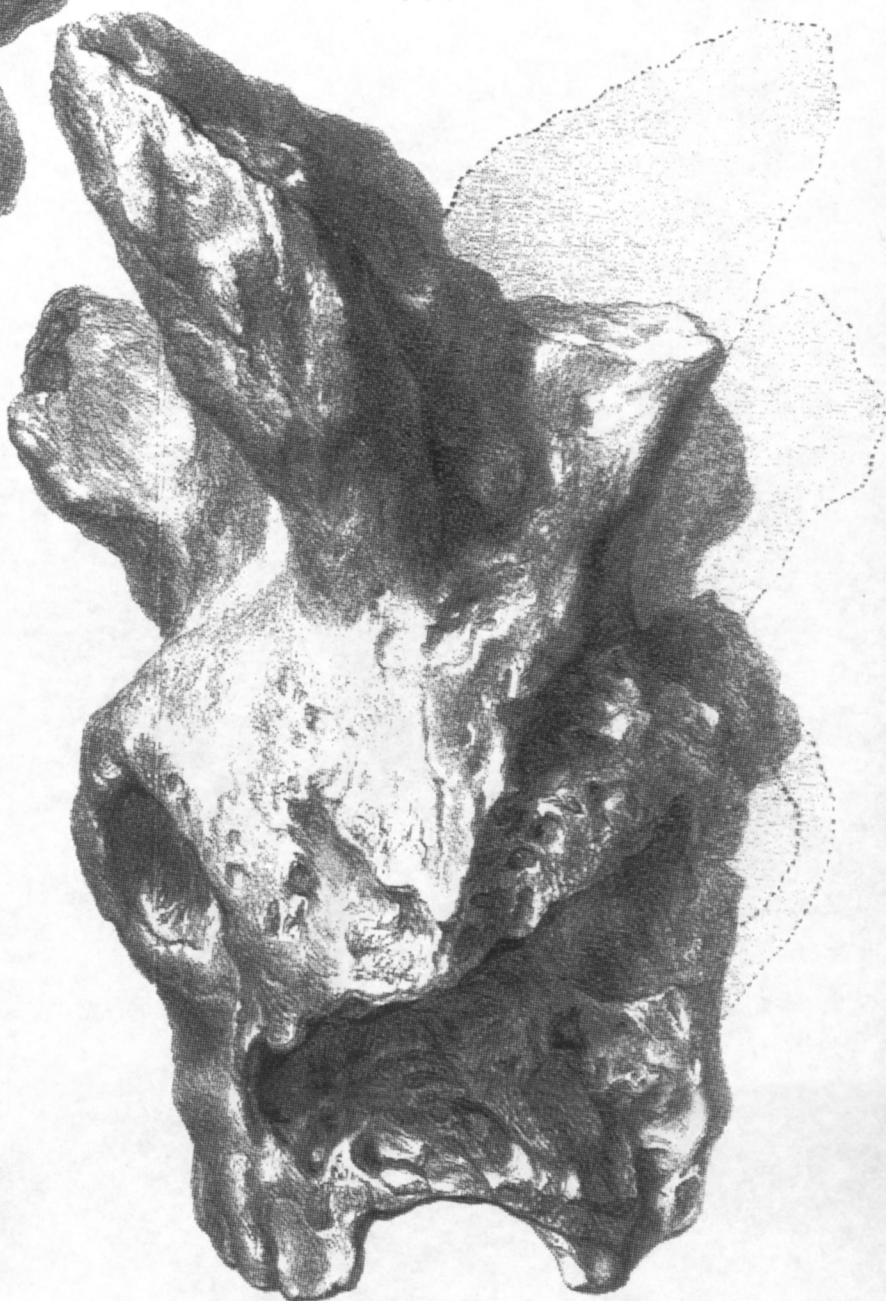
Fig. 1



Fig. 2



*Fig. 3.*



*Fig. 1.*



*Fig. 2.*



Fig. 2



Fig. 1

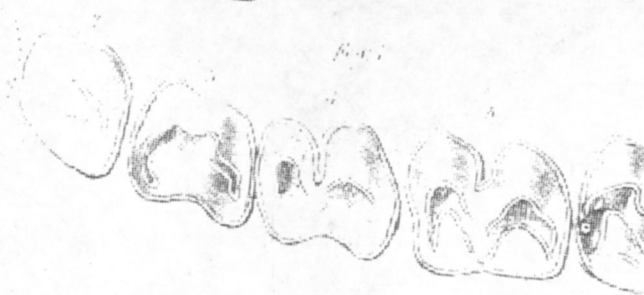


Fig. 3

Fig. 4: Front view 2 Side view 3. Prepart 4. Grinding surface



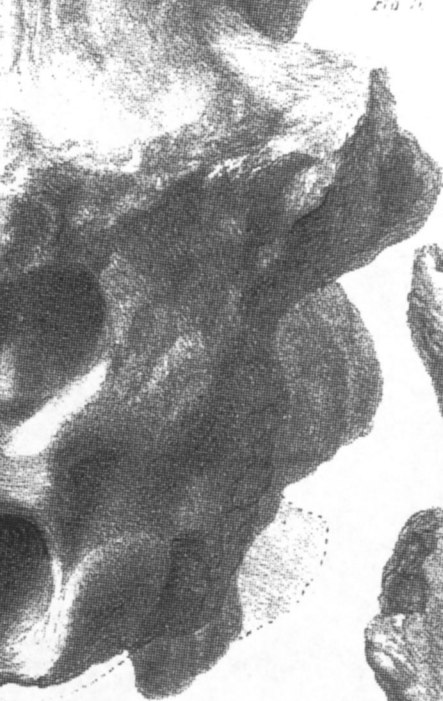


Fig. 1

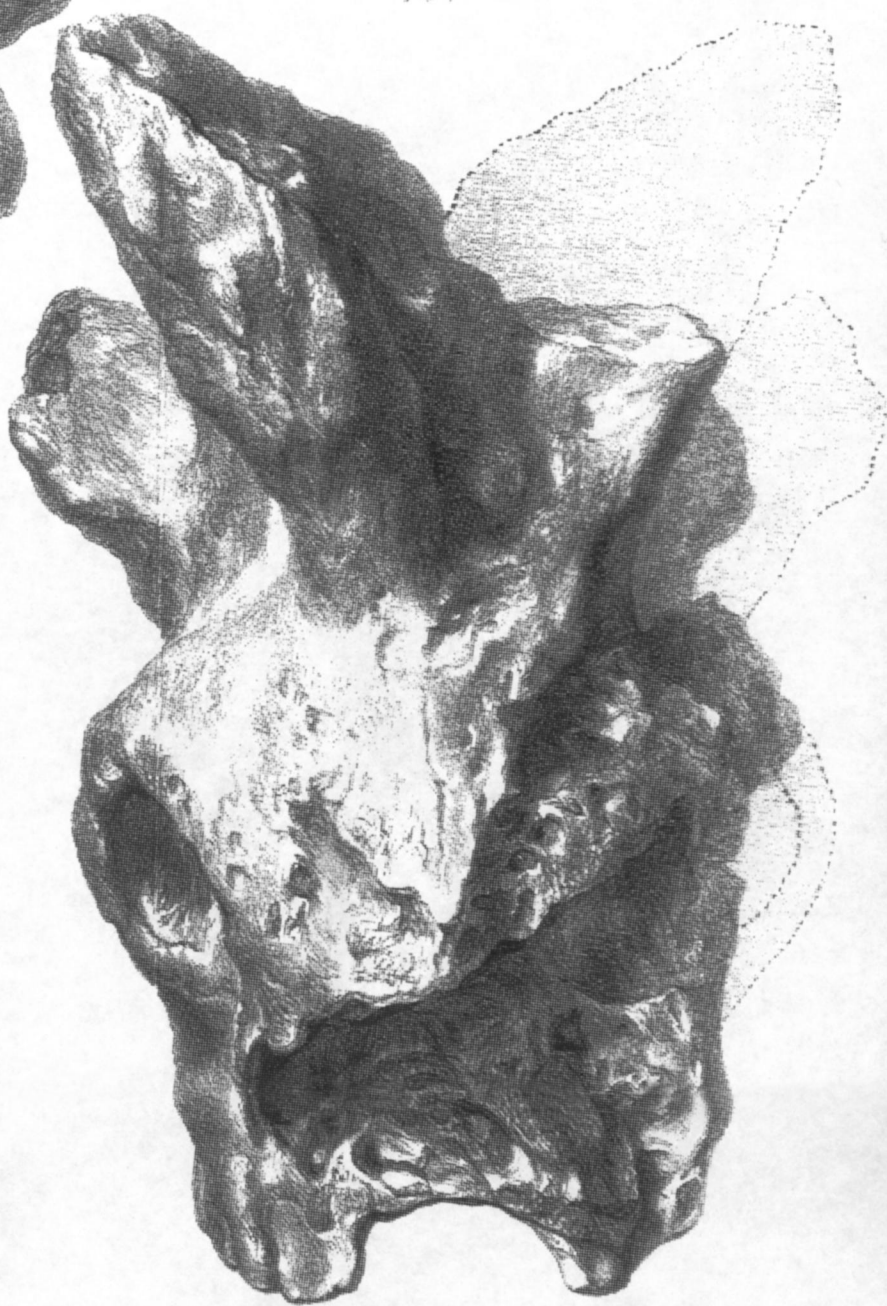


Fig. 2



Fig. 3



Fig. 4

Fig. 5: A series of four small, dark, irregularly shaped fossil specimens, possibly teeth or bone fragments, shown in profile. They are arranged in a row and have a rough, textured surface.



I imagine them to be substantially so, still they must be taken subject to correction.

*Comparative measurement of the skull of the Perim Fossil<sup>1</sup>, that of the Sivatherium, and the skull of an adult Giraffe.*

	FOSSILS.		Giraffe.
	Perim.	Sivatherium.	
From the anterior margin of the foramen magnum to the alveolus of the first molar . . .	17·375	18·05	14·125
From ditto to the truncated extremity of the muzzle . . .	17·5	20·6	24·025 <sup>2</sup>
From ditto to the posterior margin of the last molar . . .	9·75	10·3	9·
From the tip of the nasals to the upper fractured margin of the cranium . . .	16·625	18·	21·
From ditto ditto to ditto along the curve . . .	17·375	19·	21·5
From the anterior angle of right orbit to the first molar . . .	7·025	9·9	6·375
From the posterior to the fractured margin of the cranium . . .	10·5	12·1	8· <sup>3</sup>
Width of cranium at the vertex, mutilated at left side . . . (restored, about)	11·	22·	9·
Ditto between the orbits, upper borders . . .	4·25 : 8·5	12·2	11·375
Ditto ditto lower borders . . .	7·25 : 14·5	16·2	8·
Ditto behind the orbits at the contraction of the frontal . . . (about)	8·5	14·6	8·375
Ditto between the middle of the zygomatic arches . . .	. . .	16·4	8·
Ditto between the bodies of the malar bones . . .	. . .	16·02	7·
Ditto base of skull behind the mastoid processes, mutilated on both sides . . .	12·	19·5	6·25
Ditto between the cheek tuberosities of the maxillaries . . .	5·5 : 11	12·2	6·75
Ditto of muzzle portion of the maxillaries in front of the first molar . . . (about)	3·5	5·8	4·625
Depth from the convexity of the occipital condyles to middle of frontal behind the horns (fractured, about)	10·025	11·9	10·125
Ditto from the body of the sphenoidal to ditto between the horns . . .	. . .	9·94	. . .
Ditto ditto to frontal at the anterior base of the horn . . .	9·125	. . .	. . .
Ditto from middle of the palate between the third and fourth molars to ditto at root of the nasals . . . (truncated, about)	2·375	7·52	7·5

<sup>1</sup> Certain comparative measurements are impossible, by reason of the part referred to in the Sivatherium being either mutilated, or altogether non-existent, in the Perim fossil; for example, referring to the nasal arch, which has no existence in the Perim fossil, or the distance between the anterior horns, the base in the Perim fossil being confluent, and the summit on one side mutilated.

<sup>2</sup> Muzzle untruncated.

<sup>3</sup> Margin unfractured.

	FOSSILS.		Giraffe.
	Perim.	Sivatherium.	
Depth from posterior surface, last molar, to extremity of nasals . . . . . (truncated)	8.375	13.0	16.
Ditto from grinding surface, penultimate molar, to root of nasals . . . . . (about)	9.	10.3	9.625
Ditto from the convexity near the tip of the nasals to the palatal surface in front of the first molar . . . . .	. . .	5.53	10.875
Ditto from base of nasal to palatal surface in front of second molar <sup>1</sup> . . . . .	4.875	. . .	. . .
Ditto from middle of the ala of the occipital to the swell at vertex of frontal . . . . .	5.125	8.98	. . .
Ditto from inferior margin of the orbit to grinding surface, fifth molar . . . . .	5.625	7.3	4.625
Ditto from the grinding surface, first molar, to edge of the palate in front of it . . . . .	. . .	2.6	0.875
Ditto ditto second molar, first being partly destroyed <sup>2</sup> . . . . .	1.6	. . .	. . .
Space from the anterior angle of the orbit to tip of the nasals . . . . . (mutilated)	4.625	10.2	15.75
Antero-posterior diameter, left orbit . . . . .	3.875	3.3	3.5
Vertical ditto . . . . .	2.75	2.7	2.625
Antero-posterior diameter of the foramen magnum . . . . .	2.125	2.3	1.625
Transverse ditto . . . . .	1.625	2.6	2.25
Long diameter of each condyle . . . . .	3.625	4.4	2.5
Short or transverse ditto of ditto . . . . .	1.875	2.4	1.375
Interval between the external angles of ditto measured across the foramen, . . . . .	5.25	7.4	4.625

Examining the result of the comparison, some of the points most worthy of notice appear to be:—

That each being an adult of its kind, the Perim fossil was the smaller animal. From its character and power it could have been little likely to disturbance or attack from other animals, and the line of vision is lateral and anterior, but not retrospect. The orbit in the Perim fossil appears to be more prominent, placed more forward in the head than in the Sivatherium; and the osseous margin more strongly developed.

That the width of cranium at the vertex in the Sivatherium, was in the proportion of 2 to 1 above the Perim fossil. Considering the relative positions, the head of the Perim fossil was at every point of measurement more compressed in width than that of the Sivatherium. At the base of the skull behind the mastoid processes, the Sivatherium

<sup>1</sup> In lieu of the last measurement, which cannot be taken.

<sup>2</sup> *Vide* note as above.

is in excess as 19·5 to 12. A straight line drawn down from the anterior angle right orbit of the Sivatherium falls 1·125 inch behind the root of the sixth molar, the same line in the Perim fossil falls through the base of the fifth molar, or 1·875 inch more forward. Length of upper jaw measured outside from posterior margin of sixth to anterior margin of first molar in the Perim fossil is about 8·625, in the Sivatherium 10·125. The shape of the occipital condyles varies slightly; the condyles of the Perim fossil being rather more elongated transversely, with less antero-posterior depth.

In the Sivatherium it appears to me, that the occipital and parietal bones projected laterally, so that the zygomatic arch was, if I may so express it, covered or overshadowed. In the Perim fossil on the contrary, the zygomatic arch was projected much more beyond the vertical line of the skull. The zygomatic arch and malar bones are wanting, but there is enough of the zygomatic process on the right side, to mark its site and character.

I may here observe, that nearly the whole of the occiput is in beautiful preservation; and the mastoid process on the left side is quite perfect. All the parts along the base of the skull, from the first molar to the occipital condyles, are very perfect. The zygomatic fossæ are deep and well defined.

The condition of the teeth, in the opinion of competent judges, proves the animal to have been an adult. The manner in which the teeth are set in the head is worthy of notice: they are inclined upwards, so that the grinding surface of the first is at an angle with the last molars and with the base of the head, presenting altogether the same appearance as the teeth of the Sivatherium, described by Dr. Falconer; the teeth in number, form, and character, are similar to those of the Sivatherium; a comparison of the two shows the Perim fossil to be somewhat smaller, but perhaps not less than the proportion in the relative size of the two heads.

I will here only remark, that the teeth bear close affinity to those of the Sivatherium, an elaborate and detailed account of which is given in the paper by Captain Cautley and Dr. Falconer, before referred to, in the Bengal Transactions. The subject is of great difficulty, and one on which I am not competent to enter.

As to the remarkable contraction referred to, in the frontal bone of the Perim fossil, in measurement with the Sivatherium and Giraffe, I find the former to be 8·5, the Sivatherium 14·6, the Giraffe 8·375.

Another marked distinction between the Perim fossil and the Sivatherium, is in the immense difference in the width of the cranium at the vertex. The mutilation on the left side restored in the Siva-

therium gives, according to Dr. Falconer, the full width about twenty-two inches. In the Perim fossil, measuring the perfect half, from the suture of the parietals to the extremity of the transverse ridge of the occiput, (augmented it should be observed by the base of the posterior horn,) and doubling this measure, to supply the half for the side now mutilated, eleven or eleven inches and a half is the maximum attainable. So that here the Sivatherium is in excess above the Perim fossil in the proportion of two to one; in fact, at this view, no two skulls of animals of the same order can be more dissimilar; and the Perim fossil (saving always the horn) approaches nearer the character of the Giraffe.

The greatest point of difference between the two fossils is the formation and relative position of the horns. In the Sivatherium the anterior horns may perhaps be considered to bear the same relation in point of size to the gigantic posterior horns as do the anterior and posterior horns respectively of the four-horned antelope. The Perim fossil presents a remarkable anomaly; the anterior horns rise from a *confluent base* from the temporals, and covering the vertex, the base measuring twenty-five inches; the horn measured, above the line of division, eighteen inches. This formation I apprehend is without precedent in the animal kingdom fossil or recent.

An extension and prolongation of the transverse ridge of the occiput forms a protuberance, extending, at its lower edge, to the zygomatic process; its general character, cancellar structure, and extent of development, bar the supposition that it was a process for the attachment of muscles, and compel the conviction that this was a posterior horn. It shews a strong and rapid convergence of its sides to a point, indicating that its length was inconsiderable as compared with its massive base; these horns were "reflected" much in the same degree as those of the common Indian buffalo; the appearance of the animal, according to our ideas of the existing order of things, must have been truly monstrous.

The transverse ridges of the occiput are strongly defined, ending, as has been already stated, in reflected horns. The fossa for the attachment of the exterior muscles of the head is of great depth and expanse, and indicative of great power; there is great elevation of the occipital. I observe this formation referred to in Professor Grant's work in regard to the rhinoceros, as indicative of great force and power; it is applicable to the present case where great muscular power must have been needed, to give effect to a weapon of the size of the gigantic anterior horns. As the weight of this animal's head must have been greatly in excess of that of any rhino-

ceros, perhaps it may be inferred, that the cervical vertebræ were proportionably shorter; if this be admitted, it carries with it also the probability that the animal was furnished with a prehensile upper lip, or perhaps a tapir-like proboscis; though in regard to the latter supposition, I certainly can trace no manifest point of resemblance to the tapir skulls as delineated in Cuvier, "des Ossemens," tome 2<sup>nde</sup>.

From the general contour and perceptible rounding of the muzzle, which the skull is sufficiently perfect on both sides yet to shew, more particularly on the left side over the alveoli of the second, and part of the first molar, there is reason afforded to doubt if there was any considerable extension of the intermaxillary bones. The outline and slope also of what remains of the supermaxillaries and nasal bones, do not appear to indicate the existence of an arched nasal, of the character found in the *Sivatherium* and rhinoceros.

Besides this ruminant of a new genus, some of the fossils I obtained from Perim are, I believe, considered identical in character with others which have been found in the Sivalic Hills, others are as yet proper to Perim; among the latter, a new crocodilean of great size. I had some bones which, from their coarse and fibrous structure, were supposed by the late Dr. Malcolmson to have been those of Cetacea. I was under the impression that I had brought some of them to England, but I cannot find them in the collection.

There are also several specimens of *Mastodon angustidens*, and *Mastodon latidens*; among others some of that description designated by Captain Cautley and Dr. Falconer "*Sivalensis*," but which now proves to have been common to Western India. There is part of the molar of true elephas, parts of tusks of mastodon, skull and teeth of young mastodon, teeth of others still younger, teeth of the hippotherium, teeth of varieties of sus, also the head and teeth of true horse but of diminutive size, skull and horns of two varieties of antelope, teeth of four varieties of deer, horns of buffalo, teeth of oxen, skull and teeth (and a single detached tooth) of an animal supposed to be the babyroussa; a comparison with a recognized individual shewing a very marked resemblance, not to say positive identity. There are specimens of Gavial identical with that found in the Indus at the present day. Two of true crocodile, one of these being very perfect with the upper and lower jaw, and shewing a most satisfactory identity with the round-nosed animal found at the present day in most of the Indian rivers. I examined a very fine specimen of a recent individual in the Museum at Bombay, and found in this the same peculiarities as in the fossil,—the same roundness of muzzle, the same indentation in the upper jaw, the same alternation of large with

small teeth, in the same order and at the same intervals; and though the absence of the cartilage and bone which forms the extremity of the nasals, makes it impossible to say that the fossil had two orifices, through which passed the points of the canine teeth, as in the recent individuals of the genus, yet the size of these teeth, in each case, is the same; and the extension and completion of the nasals would require such an orifice in the fossil as in the recent specimen, to afford room for the point of the tooth.

There is a skull, portions of jaw and teeth, and several detached teeth of rhinoceros in beautiful preservation. I compared these with the plates, (Cuvier, des Ossemens,) shewing the teeth of the rhinoceros found in the Basin of Paris; some correspond in size and general character so nearly, that I had considered them identically the same, but I fortunately corrected my opinion by the judgment of a celebrated authority, who, agreeing that the general resemblance of some of the teeth was very striking, yet pointed out an important distinction, which is wanting in the fossil of Montmartre; this may be noted hereafter of the several specimens of Perim rhinoceros, one of which is far larger than any of those drawn and described in Cuvier.

I have also some bones and teeth as yet not recognized or doubtful.

There is a great field for further inquiry as to the Perim fossils. I have sent to India to obtain some of the specimens I left there, and I have also taken steps to prosecute the search at Perim; the whole subject will have my best attention, and I trust to have hereafter opportunities of directing and superintending the search in person. Now or then, should there be any results deserving it, I shall be proud to communicate them to the Society.

Three views of the head and the grinding surface of the teeth have been lithographed together, and proofs forwarded to the Society.